Buried perennial ice at low latitudes on Mars: Implications for the MSL Landing Sites

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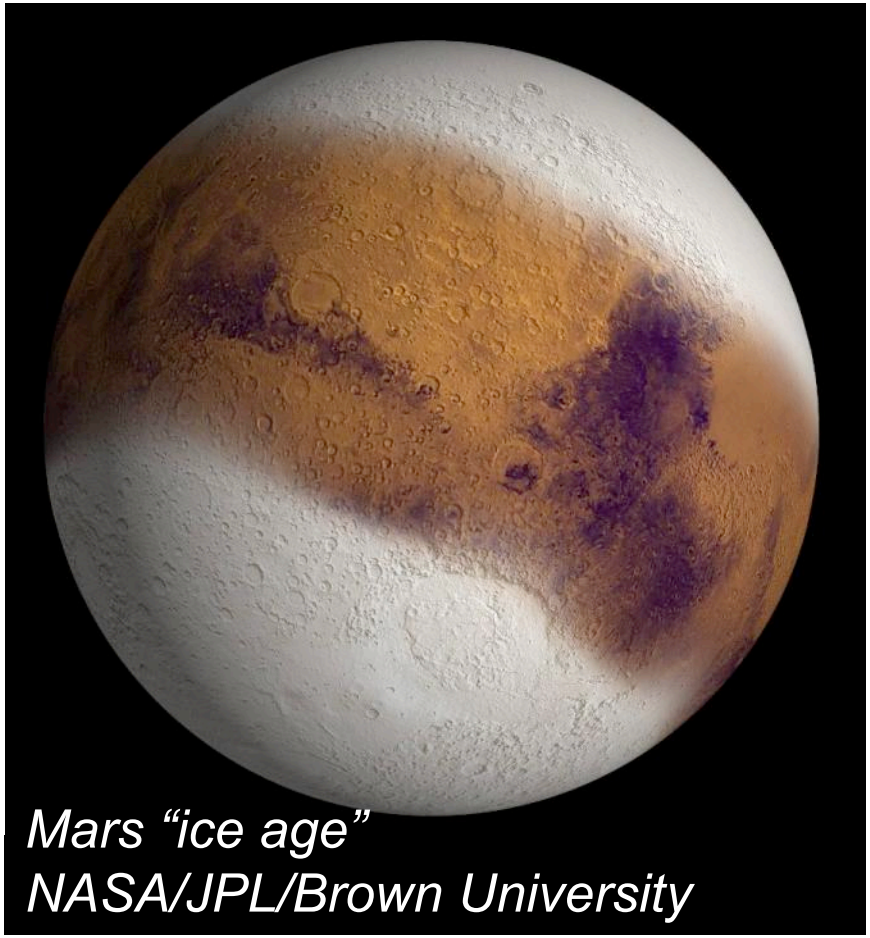
- Water ice may be buried to very low latitudes
- Remnants of previous glacial eras or ongoing vapor diffusion
- Important to assess relevance to MSL Landing sites



Mars "ice age"
NASA/JPL/Brown University

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Sciences de l'environnement Institut Pierre Simon Laplace

IAS orsay

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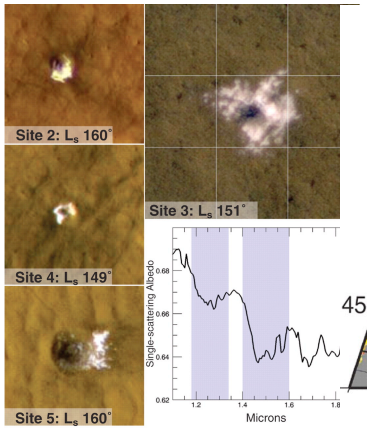
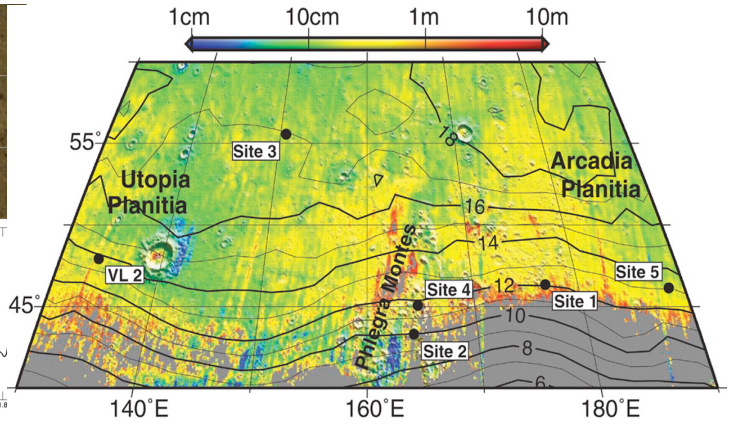
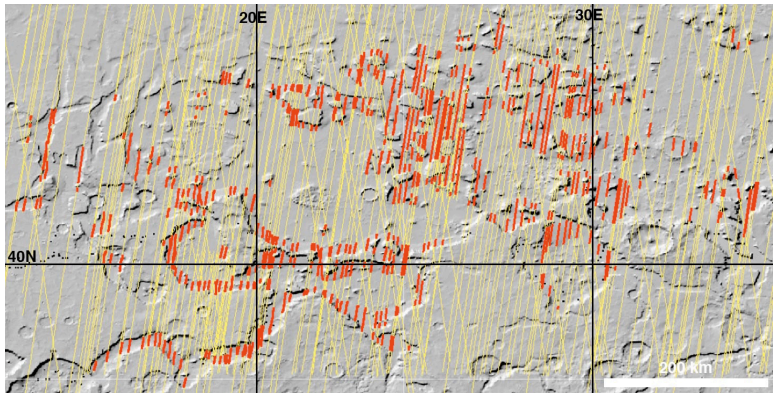
The Johns Hopkins University
APPLIED PHYSICS LABORATORY

Expanding Evidence for Buried Water Ice in Mid-Latitudes

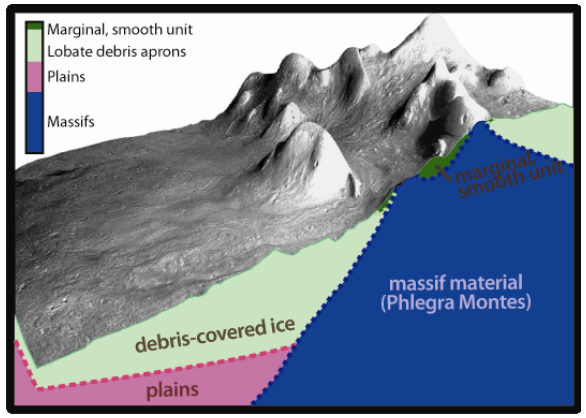






- Recent impacts excavate mid-latitude ground ice that sublimates in a few months
- Predicted by models and show the most equator-ward presence of water ice in the near surface (41° N)

Byrne et al., Distribution of Mid-Latitude Ground Ice on Mars from New Impact Craters, Science 325. no. 5948, pp. 1674 - 1676, 2009

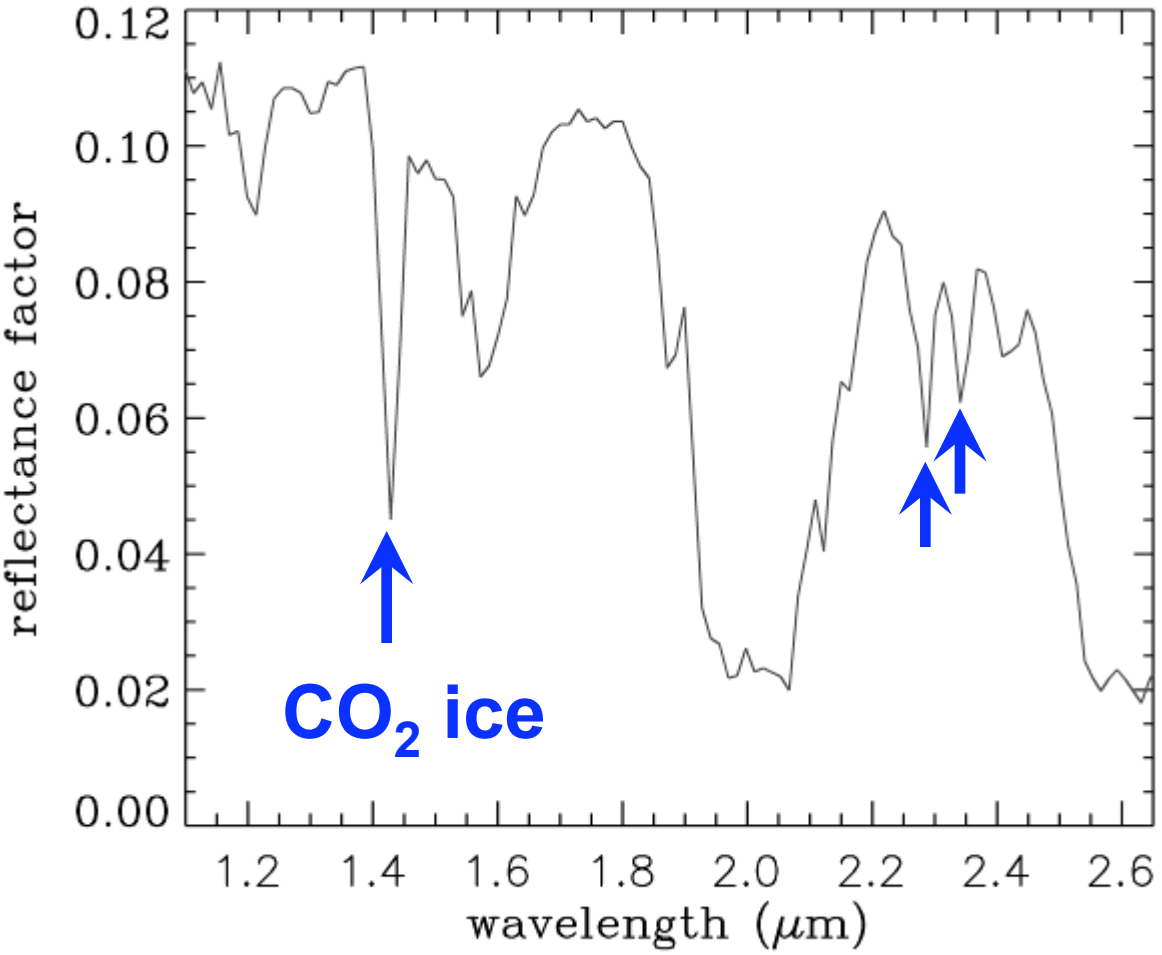


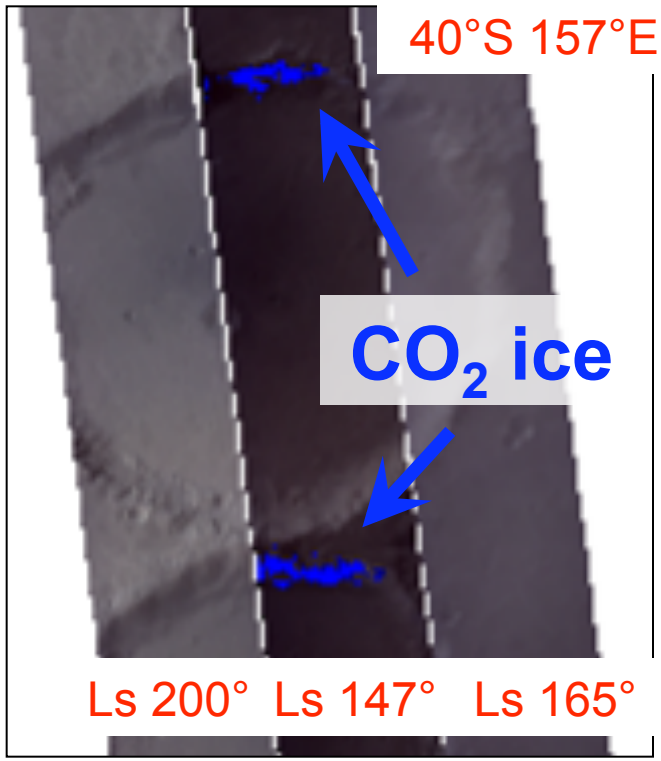
Sharad is mapping vast regions of buried ice in the mid-latutudes, south pole region, and elsewhere

Ancient ice deposited during past climate excursion

Plaut et al.,, 2010, Kress et al., 2010

Detection of present-day surface frosts using diagnostic vibrational absorptions present in **Near-IR observations** (OMEGA & CRISM)



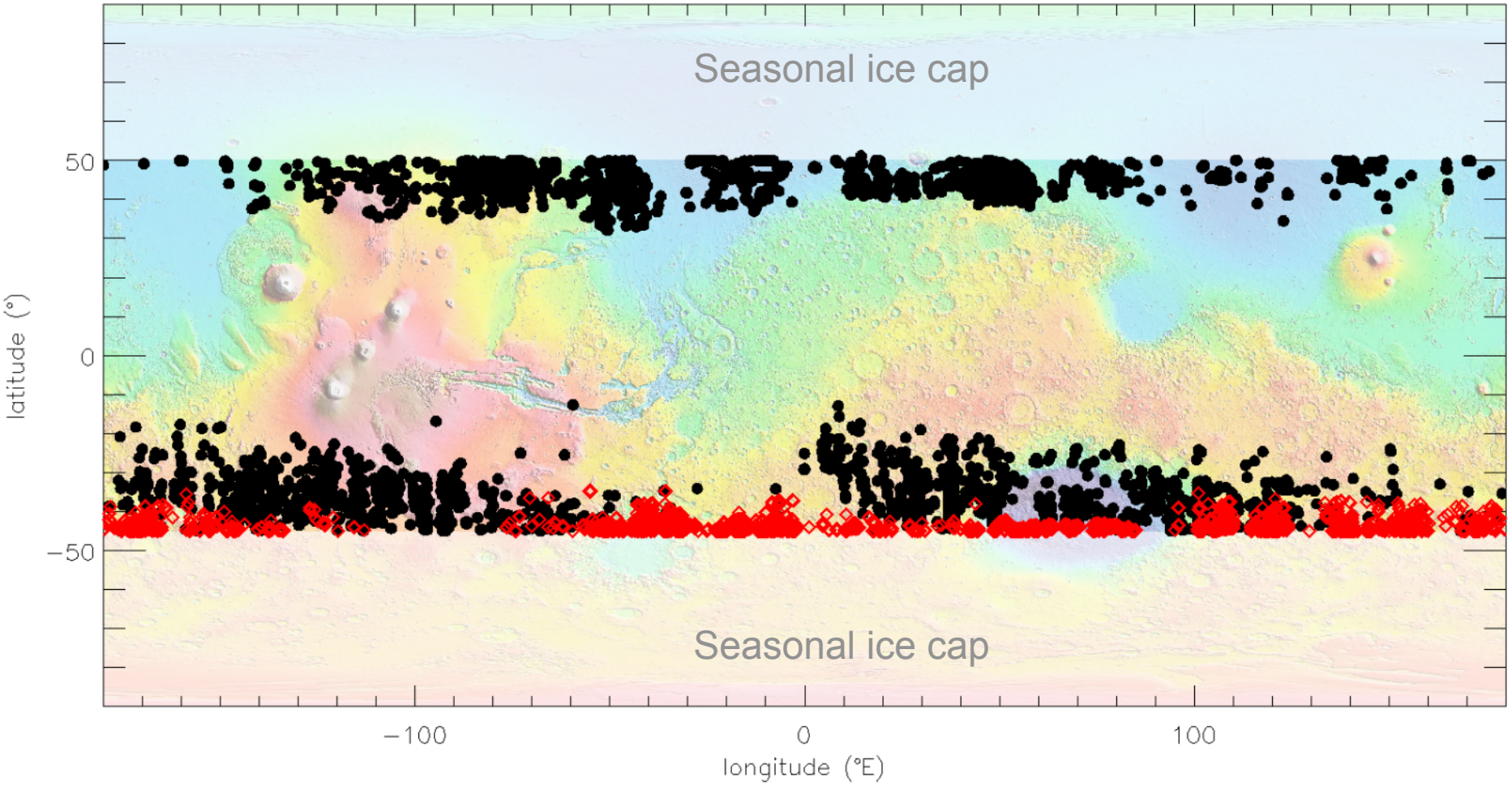


Global integrated observations of surface frosts at low/mid latitudes with OMEGA and CRISM

● H_2O ice

◇ CO_2 ice

Are these observations consistent with Model Calculations of H_2O and CO_2 ice stability?

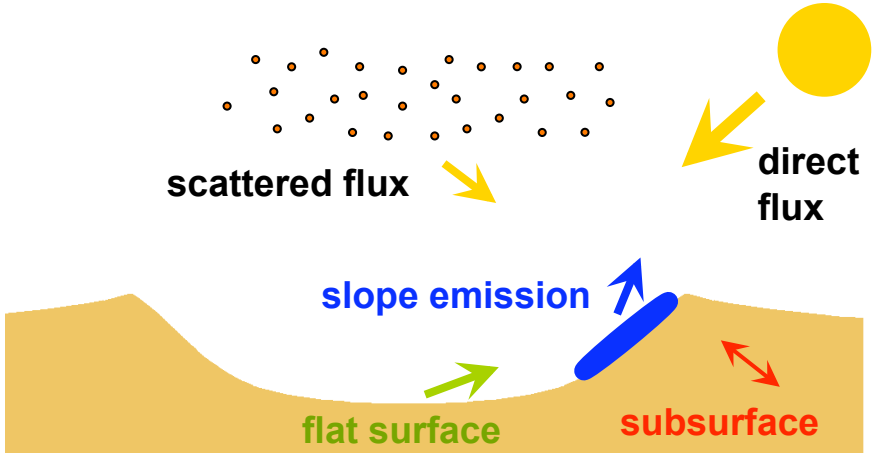


We combine:

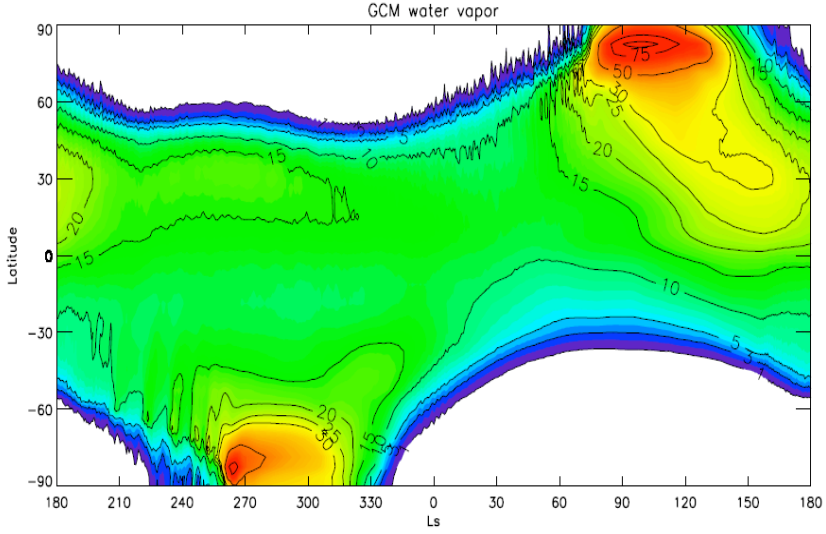
- the **1D model** designed for surface slopes

+

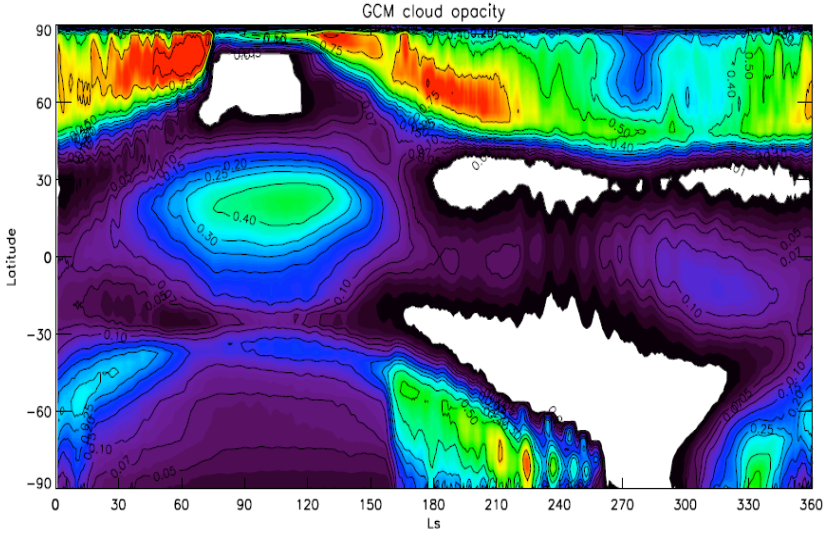
- seasonal maps from the **3D GCM**



Water vapor pressure:



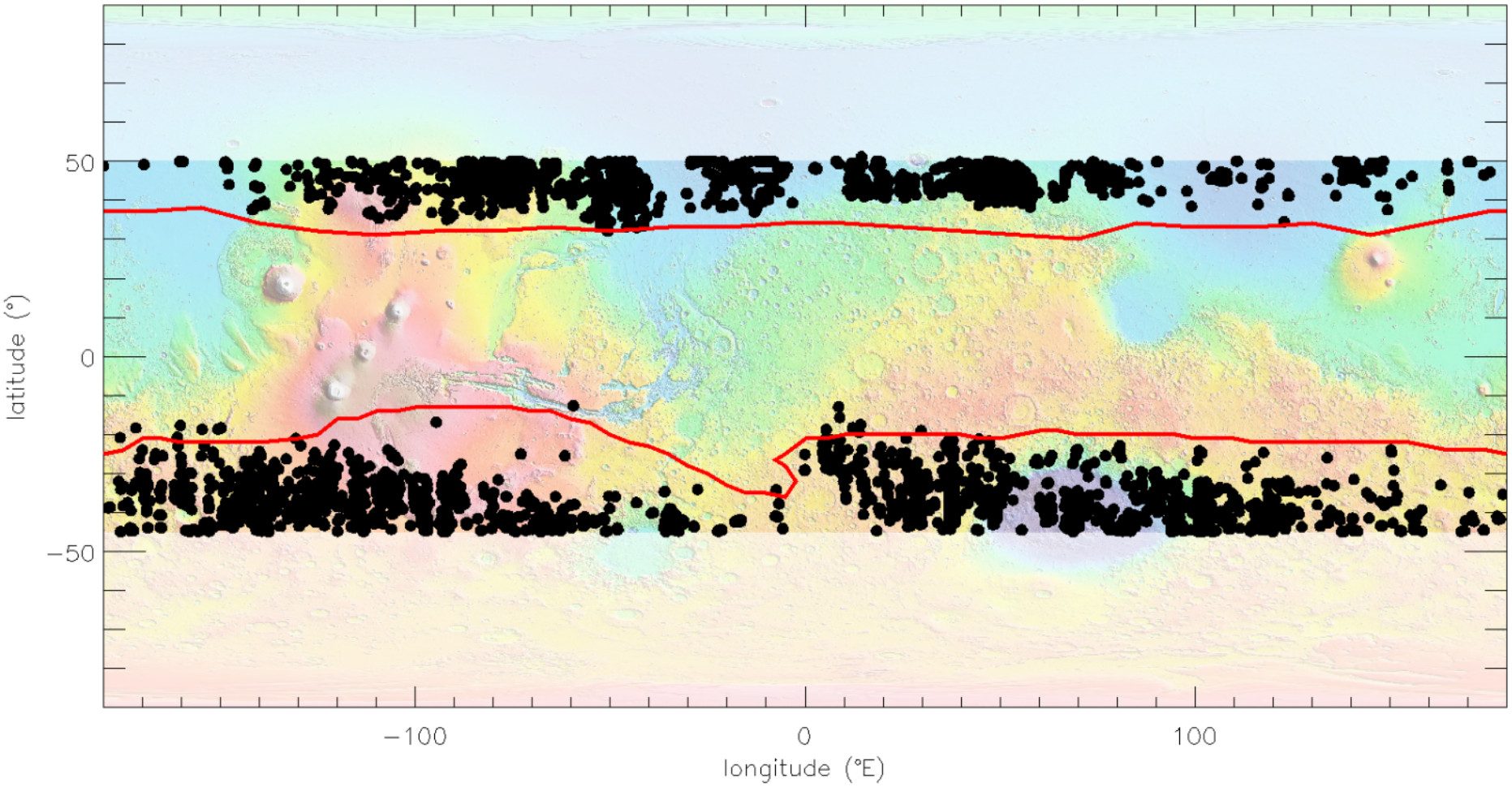
Clouds → Precipitation:



(Figures from Montmessin et al., 2004)

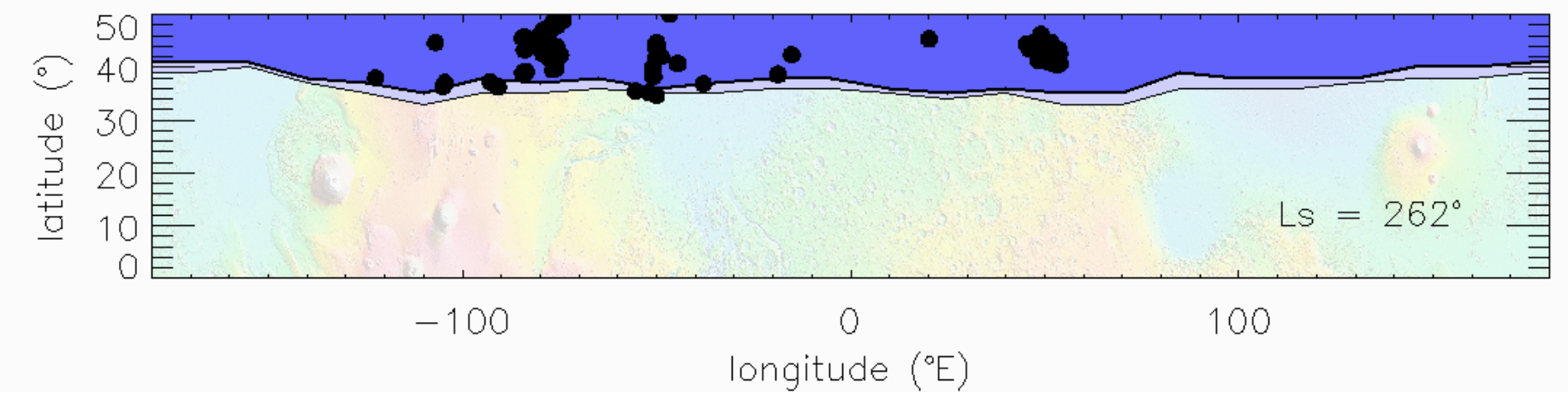
Model compared to **observations**

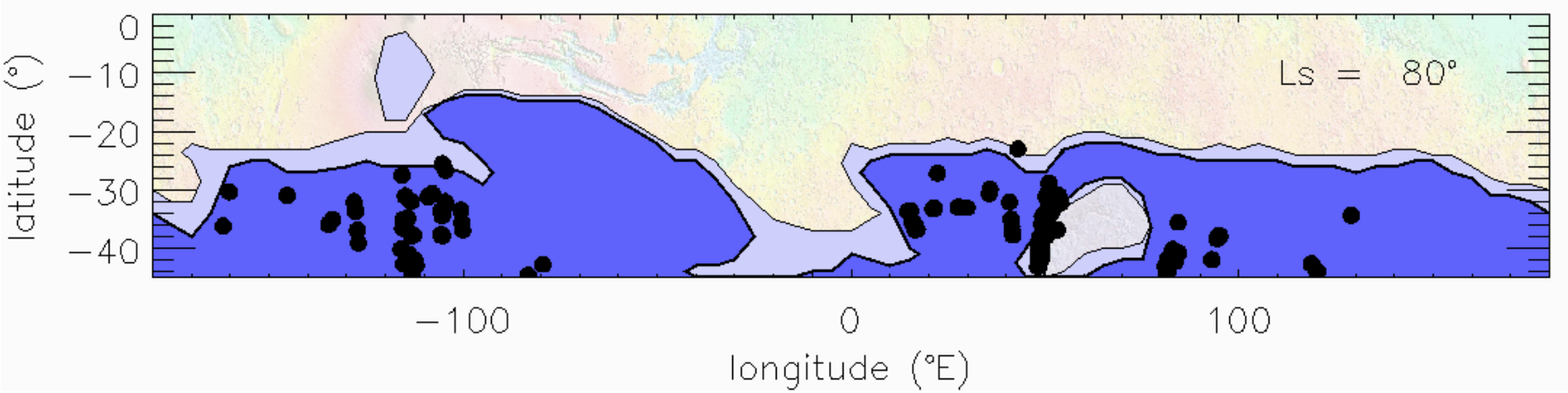
Water ice: OK



Observations (Water ice)

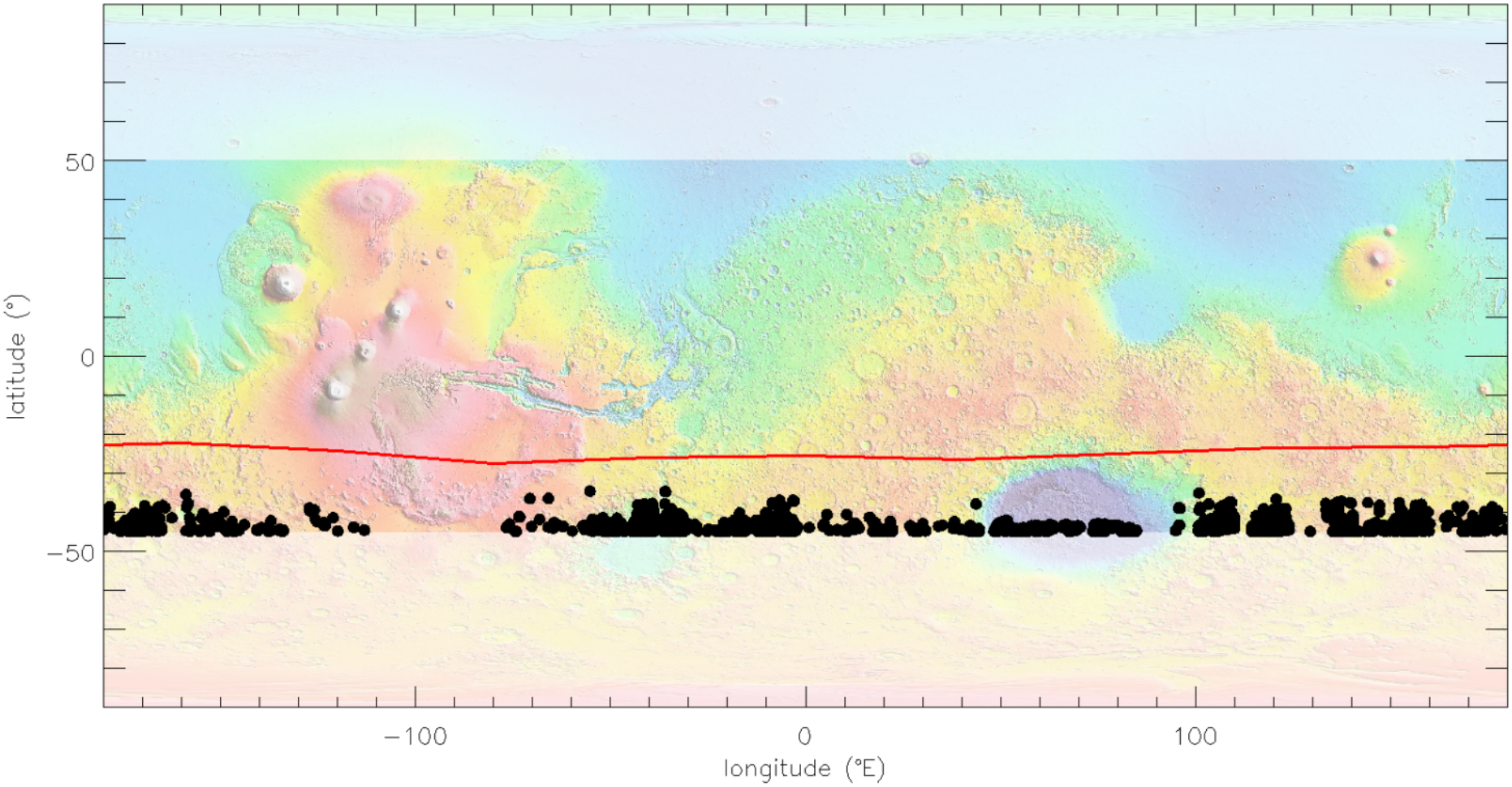
Model (thickness threshold: 5 µm / 2 µm)



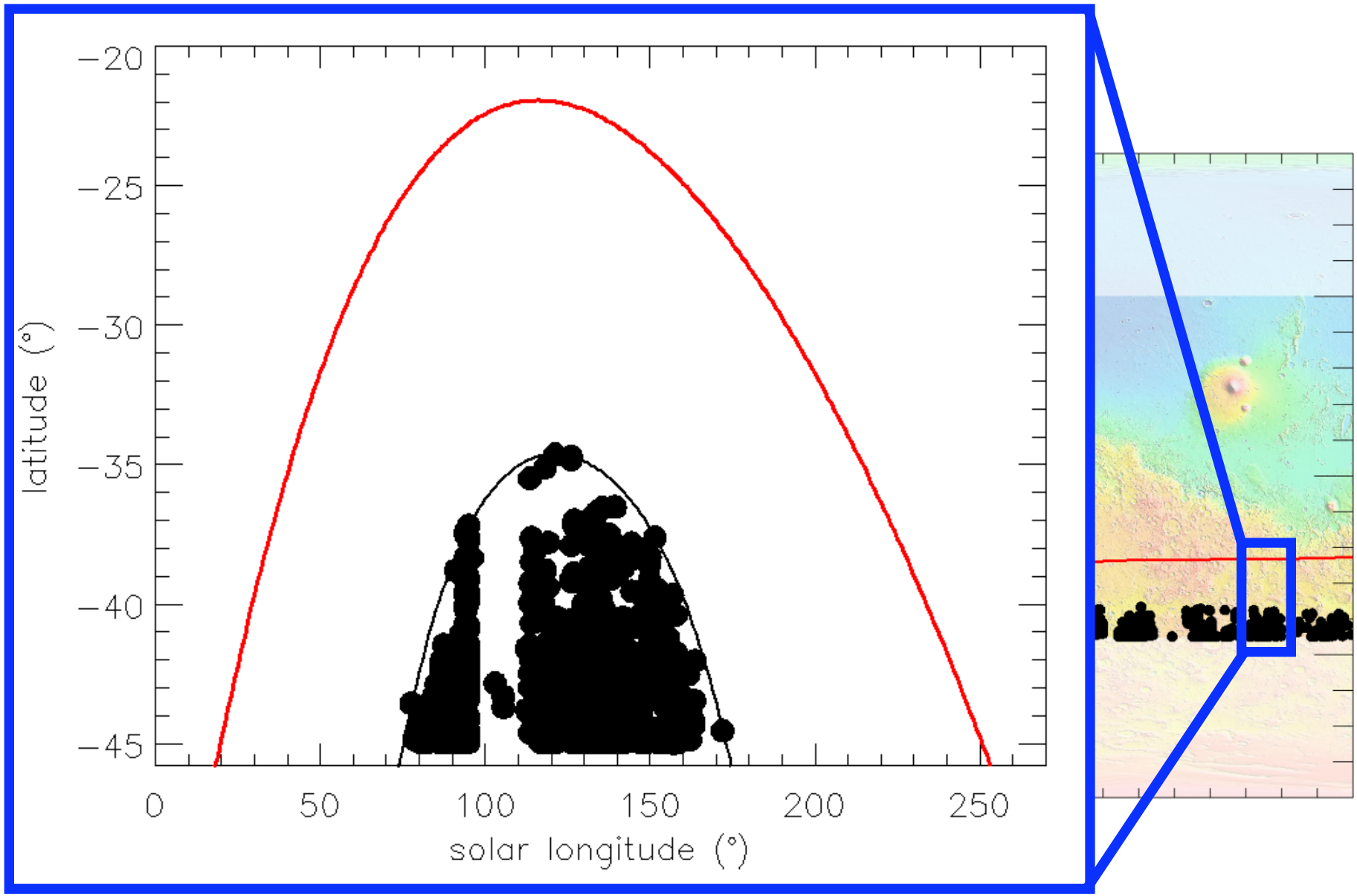


Model compared to **observations**

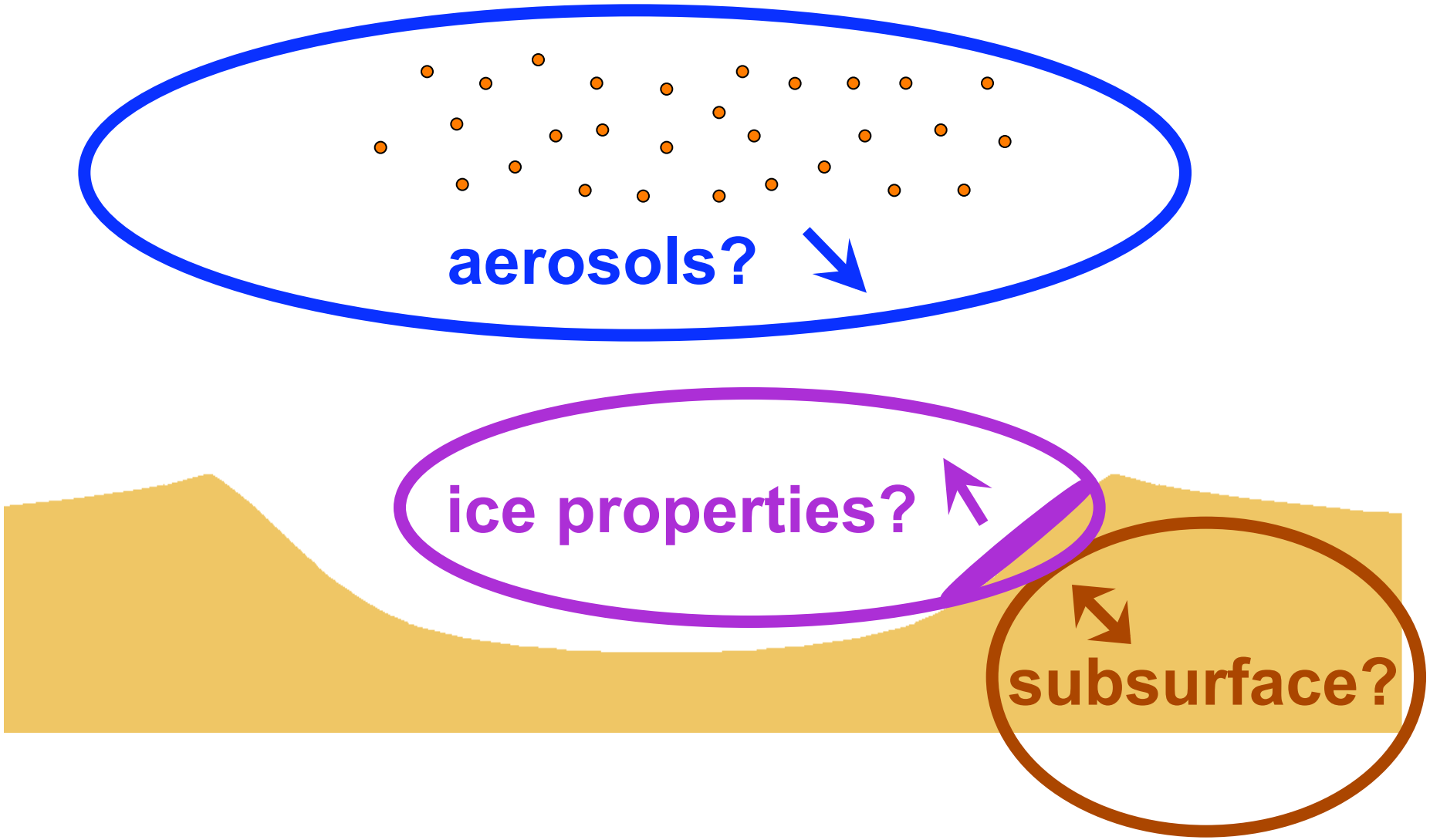
CO_2 ice: not OK



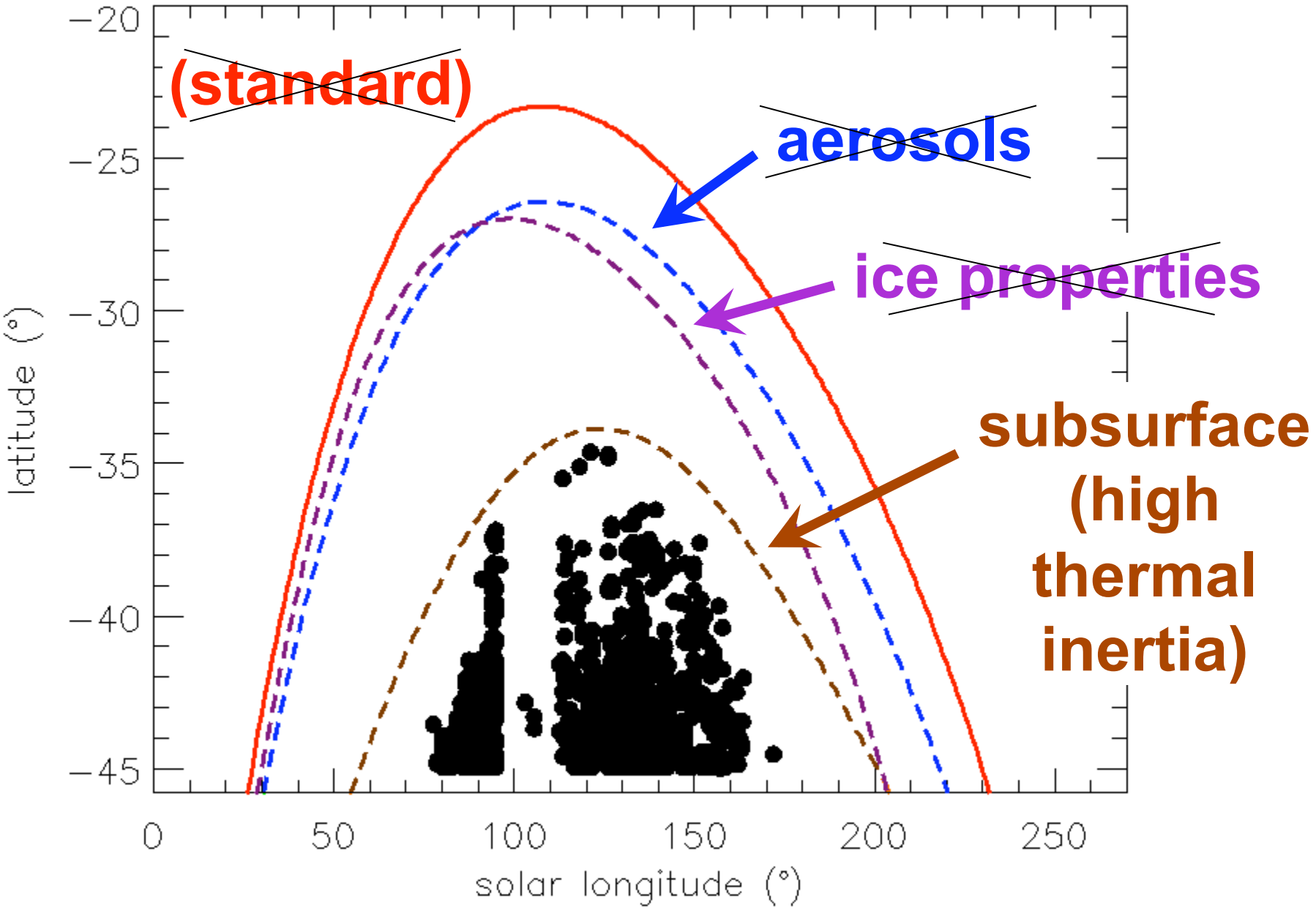
Model compared to **observations** (CO_2 ice)



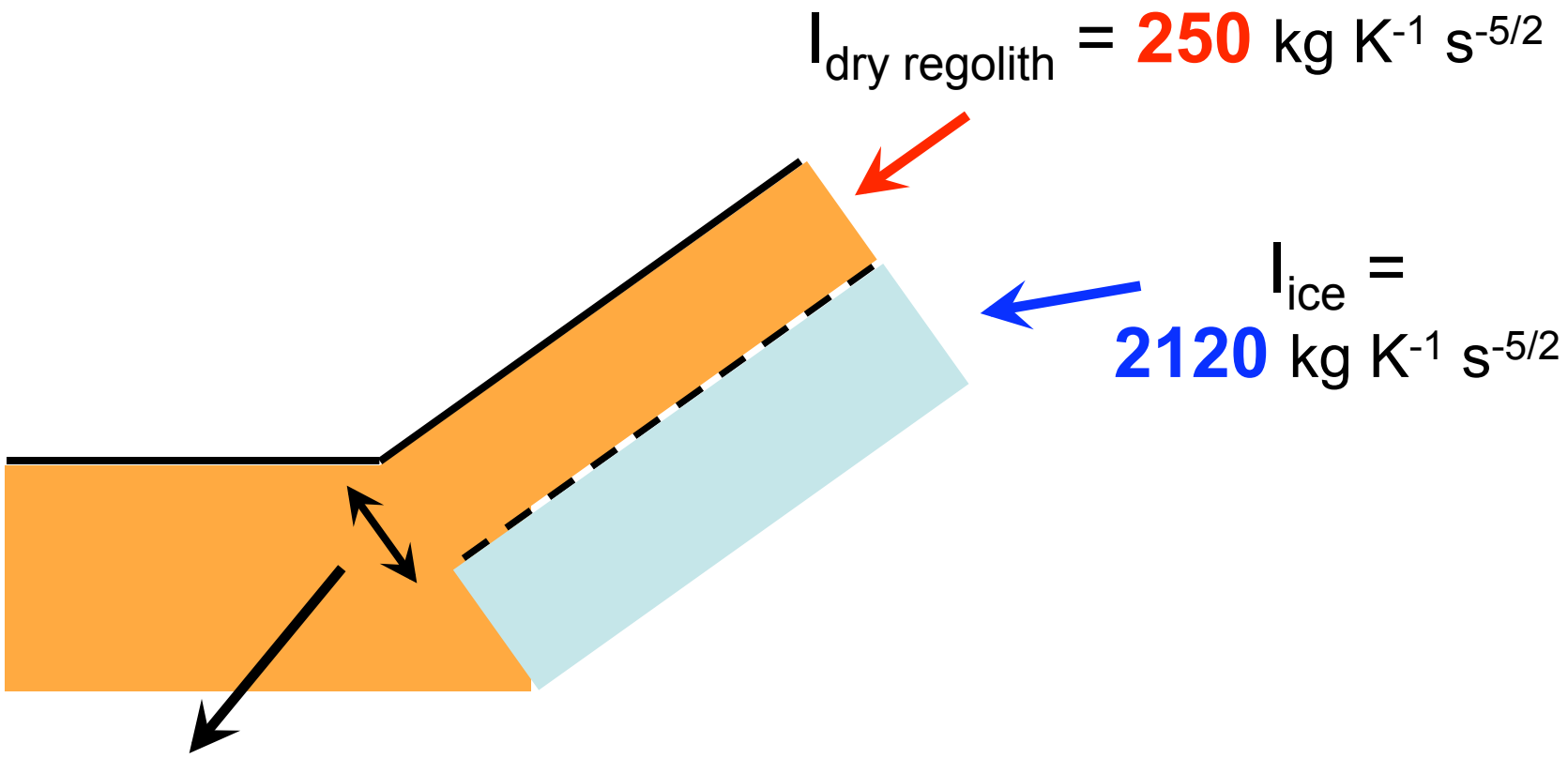
A source of heat localized on slopes is required



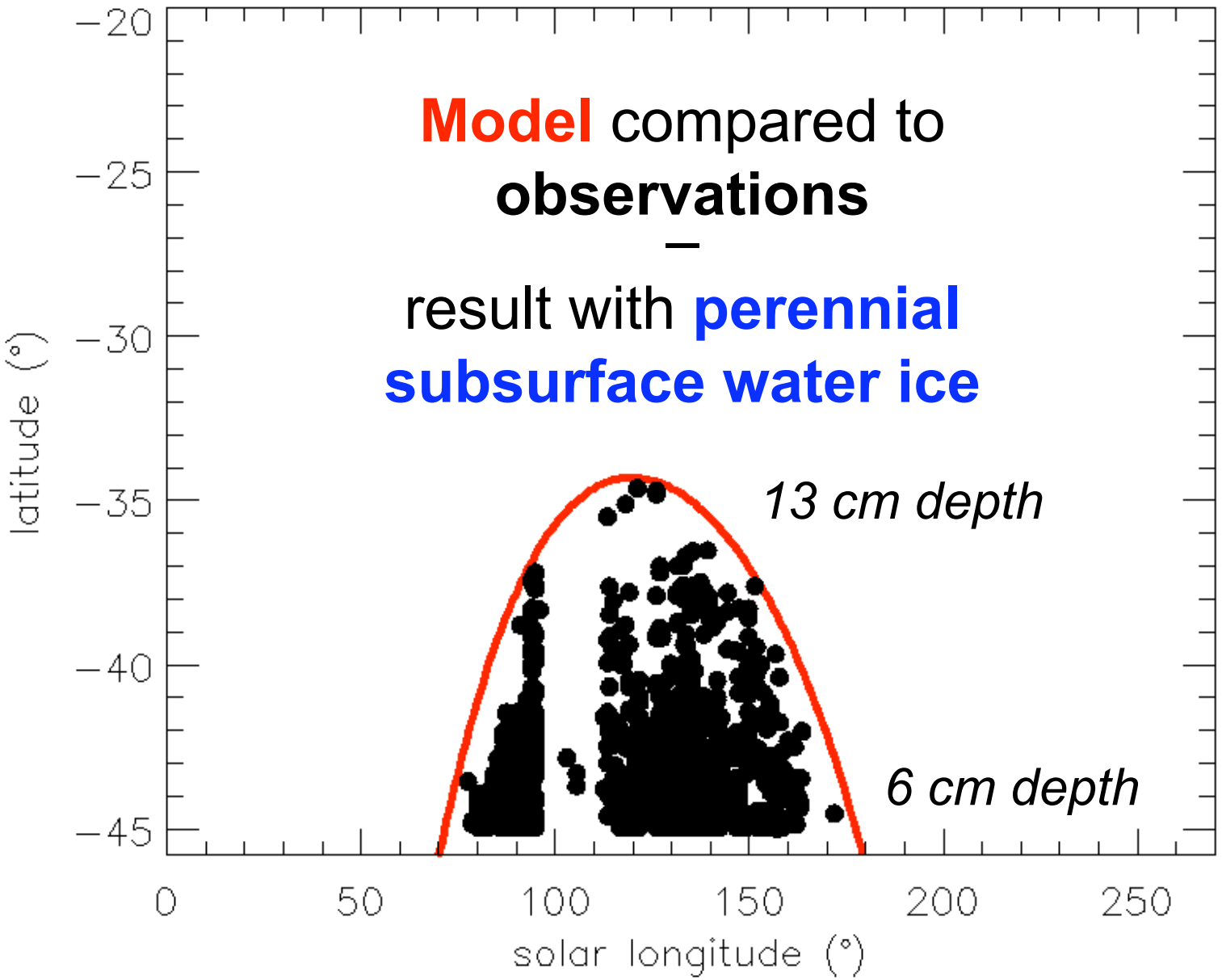
Different assumptions for model parameters



Ground model:
dry regolith above H_2O ice rich regolith

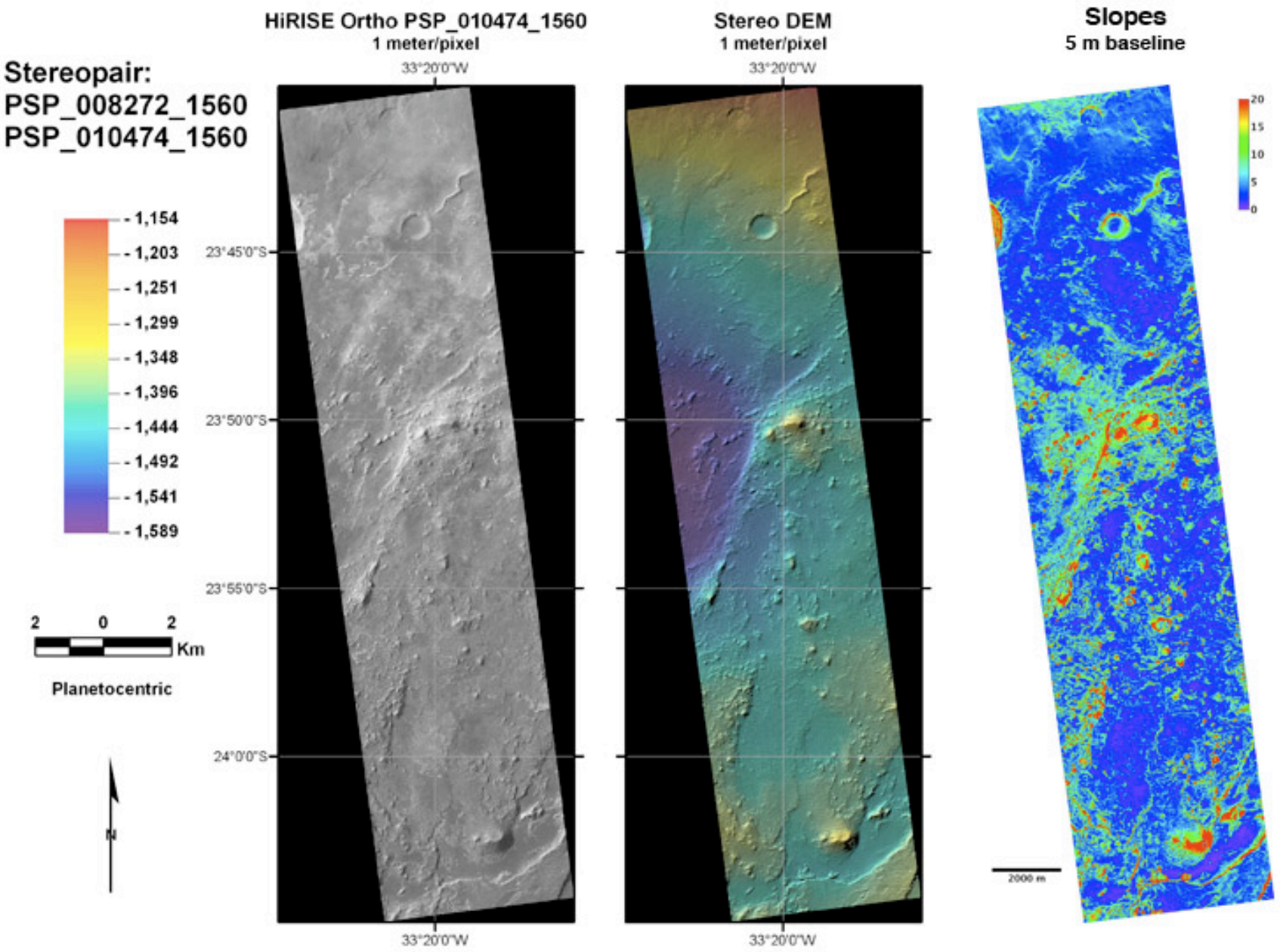


Ice table depth: free parameter, latitude dependent

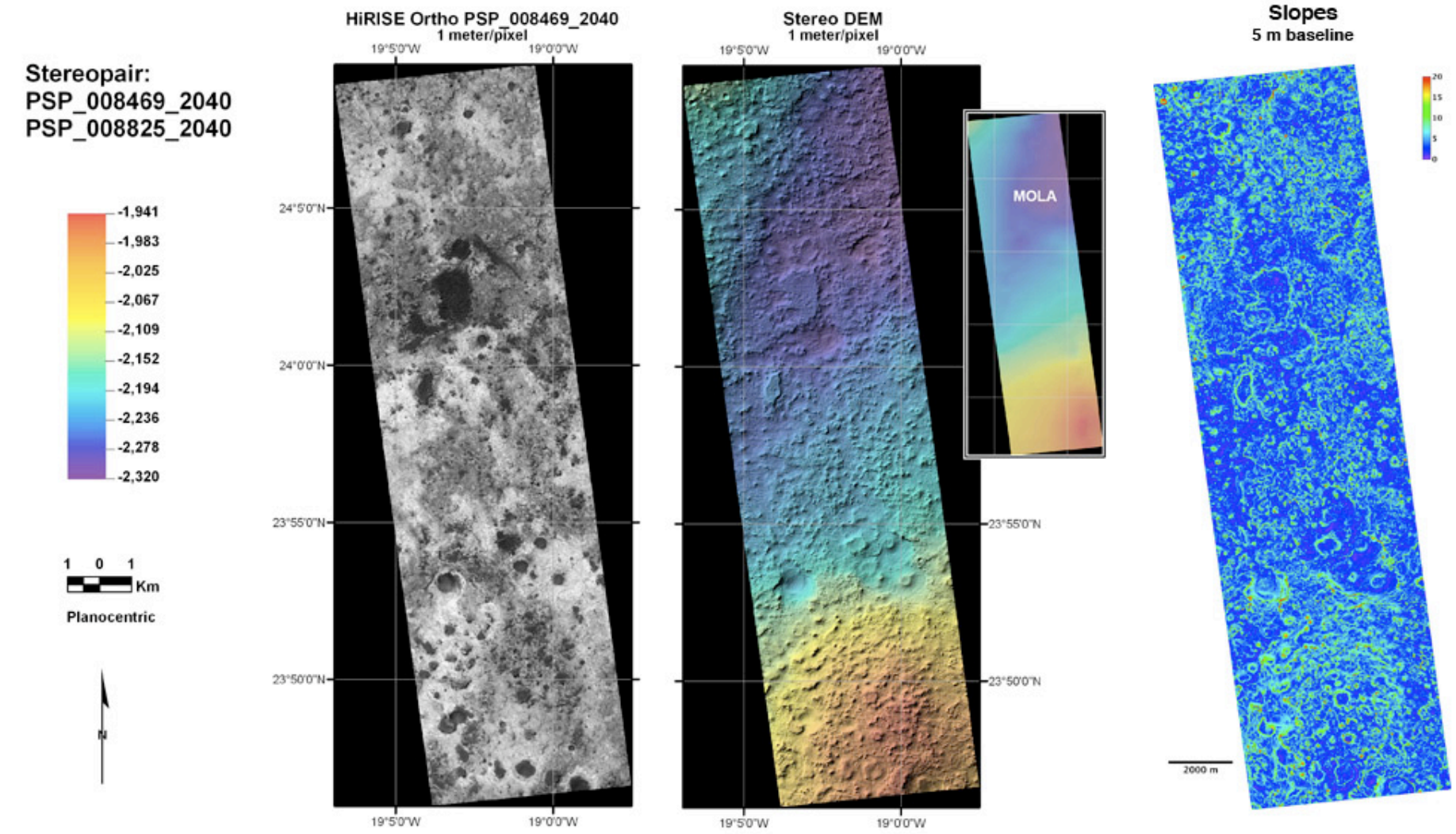

Model compared to
observations
–
result with perennial
subsurface water ice
13 cm depth
6 cm depth
−20
−25
−30
−35
−40
−45
latitude (°)
0
50
100
150
200
250
solar longitude (°)

Eberswalde W of Center

Kirk, 5th Landing Site Workshop



Mawrth2 W of Center



Implications for MSL Landing Sites

- This **observational evidence** for **perennial water ice** in the shallow subsurface (< 1 m) down to the **tropic** (25°S) is consistent with models (e.g. Aharonson and Schorghofer 2006)
- These ice reservoirs are **with the latitude range of Holden, Mawrth and Eberswalde**
- This could affect operational procedures and the clumping/texture/ aggregation of soils (e.g. Viking and Phoenix)